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ABSTRACT

Data from a sample of 2,593 high school seniors (58% female) were used to study the relationship between courses taken and scores on the American College Testing (ACT) English Usage Test, the ACT Mathematics Usage Test, the ACT Social Studies Reading Test, and the ACT Natural Sciences Reading Test. For English and Mathematics, test performance tended to be higher with a higher number of relevant courses taken. For social studies, the picture was less clear, with courses in History and Economics appearing helpful. Many factors contributed to scores in Science, but test performance was related to courses taken. Numerous tables provide descriptive data for correlations by subject. (SLD)

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Student Course-Taking Patterns and Performance on the ACT Assessment

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INTRODUCTION

The relationship of course taking to performance on standardized tests has been studied largely in the context of explaining test score differences for status groups, primarily those based on race or sex. Such studies address the hypothesis that differential coursework accounts, at least in part, for observed score differences between males and females, and among different racial groups. The debate between Benbow and Stanley (1980, 1983) and Pallas and Alexander (1983), which focuses on course-taking differences as explanative of the male-female gap in scores on quantitative SAT performance, illustrates this approach. These studies have generally found that the size of the score difference between groups is reduced when course taking is accounted for.

The focus of the present study is somewhat more general. One of the effects of recent concerns about the quality of education (best symbolized, perhaps, by A Nation at Risk) has been a renewed interest in the degree to which the achievement of all students might be enhanced with additional coursework. While it may seem axiomatic that additional coursework would improve student academic performance in the specific subject area covered by the course, these effects are typically difficult to isolate. Education is a diffuse process, resulting from numerous interactions of the student's physical and mental health, academic ability, family circumstances, role expectations, academic resources, and interests. Because of the complexity of these interactions, it remains possible to interpret the same data quite differently.

For example, Pallas and Alexander (1983, p. 165) state: "We find that the male-female gap in SAT-M performance shrinks considerably when sex

differences in quantitative high school coursework are controlled. These findings suggest that increasing female rates of enrollment in high level mathematics courses would greatly reduce the sex difference in quantitative SAT performance..." If, however, additional females are enrolled without the necessary background, ability, and interest to profit from the coursework, it seems unlikely that their scores would improve dramatically. Alexander and Pallas (1984) recognize this distinction in a later study, suggesting that completion of the "core curriculum" is effective in improving senior-year SAT performance only if the students performed well (received high grades) in those courses.

Another complex aspect of the relationship between course taking and achievement is the degree of congruence between the content of the coursework and the content of the test used to index achievement. Schmidt (1983) found that the strongest relationships between curriculum and achievement were to be found for those academic areas in which student learning was most likely to be school-dependent, for example, mathematics. In academic areas where experiences outside the school are likely to affect students' performance (reading, for example), the relationship is less close.

Laing (1986) reports that "On the average, students who have taken more coursework in the college preparatory curriculum areas of English, mathematics, natural science, and social studies earn higher standard scores on the corresponding ACT test." The most substantial difference (10 standard score points) was in mathematics, with smaller differences in science (8 points), English (3.5 points), and social studies (3 points). Laing cautions that the study addresses only the quantity of courses taken as no data on the quality of the individual courses taken by the students were available.

METHODOLOGY

Instruments

The ACT Assessment includes a measure of educational achievement in each of four content areas: English Usage, Mathematics Usage, Social Studies Reading, and Natural Sciences Reading. The English Usage Test measures students' understanding and use of the basic elements of effective writing; the Mathematics Usage Test, students' ability to solve practical, quantitative problems; the Social Studies Reading Test, problem-solving, background knowledge, and reading skills in the Social Studies; and the Natural Sciences Reading Test, scientific reasoning, background knowledge, and reading skills in the sciences. ACT test scores are reported on a standard scale that ranges from 1 to 36.

The Student Profile Section (SPS), completed by students at the time of registration for the Assessment, enables students to provide information about their backgrounds, extracurricular activities, academic needs, housing plans, financial needs, expected academic major, and career plans. The appendix provides a copy of the Student Profile Section.

Concurrent with the completion of the SPS, students also complete a survey of basic information about the courses they have taken or plan to take in high school, and the grades earned in each completed course. The thirty courses listed comprise those that customarily are required for admission to postsecondary institutions. The thirty courses are:

English

English taken during the 9th grade
English taken during the 10th grade
English taken during the 11th grade
English taken during the 12th grade
Speech

Mathematics

First-year Algebra (Algebra I; not pre-Algebra)
Second-year Algebra (Algebra II)
Geometry
Trigonometry
Calculus (not pre-Calculus)
Other Math beyond Algebra II
Computer Math/Computer Science

Natural Sciences

General/Physical/Earth Science
Biology
Chemistry
Physics

Social Studies

U.S. History (American History)
World History/World Civilization
Other History (European, State, etc.)
American Government/Civics
Economics (Consumer Economics)
Geography
Psychology

Languages

Spanish
French
German
Other Language

Arts

Art (painting, etc.)
Music (vocal or instrumental)
Drama/Theater (if taken as a course)

For courses the student has already taken for at least a full term, the student is requested to indicate the final grade received rounded to the closest letter grade. Grades are not reported for courses not completed.

Sample

Data for these studies were drawn from a sample of college-bound high school seniors on a randomly selected form from the October 1985 administration of the ACT Assessment. The total number of students tested was 2593. Of these 58% were female and 42% were male. Eight racial groups were represented, but there were sufficient data available for analysis only for whites (N = 254, 80% of the sample) and blacks (N = 117, 5% of the sample). Percents of students reporting various grade point averages were: A - 22%, B - 28%, C - 22%, D - 19%, and F - 9%. Percentages do not add to 100% because of missing data.

Analyses

Regression analyses were performed separately for each of the four test content areas. Dependent variables included raw scores for each of the four tests, as well as subscores based on subgroups of items classified as follows:

English	Mathematics
Punctuation	Elementary Algebra
Grammar	Intermediate Algebra
Sentence Structure	Geometry
Diction and Style	
Logic and Organization	
Social Studies Reading	**Natural Sciences Reading**
History	Physical Science
Government	Biology
Economics	Chemistry
Psychology	Physics

Independent variables included total high school GPA, race, sex, size of graduating class, and course grades. A dummy variable reflecting whether or not a course had been taken was developed for each of the courses analyzed.

Regression questions were formed using as dependent variables the total score and subscores for a specific content area and as independent variables the courses in the same content area. That is, performance in Natural Sciences Reading was not explained from coursework in English, Social Studies, or Mathematics. However, for the English courses, the information on speech and foreign language taken was also included for some analyses.

Regression analyses were performed independently for each of the four content areas and related subscores. All analyses employed forward stepwise regression and were performed in the following combinations:

1. Course grades regressed on total score and subscores;
2. Course taken regressed on total score and subscores;
3. GPA or grade received in a common course and course taken regressed on total score and subscore';
4. GPA or grade received in a common course, race, sex, graduating class size, and course taken regressed on total score and subscore';
5. GPA or grade in a common course regressed on total score and subscore separately for males and females;
6. GPA or grade in a common course regressed on total score and subscore separately for blacks and whites.

For English, the number of semesters of foreign language was also included in some of the regression analyses. Additionally, cross-validation using a parallel form of the test with a randomly equivalent sample was performed for at least one of the regressions in each subject area.

2. English Usage Courses and Scores

RESULTS

The ACT English Usage Test is a 75-item, 40-minute test that measures the student's understanding of the conventions of standard written English in punctuation, grammar, sentence structure, diction and style, and logic and organization. The test does not measure the rote recall of rules of grammar, but stresses the analysis of the kind of effective expository writing that will be encountered in many postsecondary curricula. The analysis of the relationship of course taking to English Usage scores was conducted based on the performance of 2271 examinees on a randomly selected form of the ACT Assessment English Usage Test. The examinee group included 977 males and 1377 females. There were 2237 white examinees and 117 blacks; other racial groups had too few examinees for separate analysis.

Descriptive data for the variables used in the study are presented in Table 2.1 (page 2-8). The average raw score was 47.38 on the 75-item test (63% correct). Item classifications were used to create subscores for the purposes of this study only; they are not reported for the ACT Assessment. Average subscores ranged from 50% to 78% correct.

Most of the students had taken four years of English (90%); virtually all of them had completed three years. Average self-reported grades in English ranged from about 3.0 to 3.2 on a four-point scale. However, this was somewhat inflated by the exclusion of grades of F for examinees who reported failing a course. These examinees were treated as not having taken the course for the purpose of this study.

Data on the number of semesters of foreign language taken and Speech coursework were also included in the analyses as many foreign language and Speech courses focus on the kind of language analysis that would help performance on the English Usage Test. In addition, race, sex, and size of the graduating class (a rough index of population density) were included.

Course Grades, Courses Taken, Demographics Analyses

Correlations between the total English Usage score and subscores and courses taken, course grades, semesters of foreign language, and demographic variables are presented in Table 2.2 (page 2-9). Correlations are not reported for taking Grade 9 English because that variable had no variance: everyone in the sample had taken English 9. Low variance was also the rule for the other English courses taken. As a result, their correlations with other variables are also low. Grades in the English courses, however, had more variance and correlated more highly with the scores. Correlations between English grades and scores ranged from .31 to .44; those for Speech grades and English scores ranged from .22 to .30.

Semesters of foreign language had much lower correlations with scores; these correlations ranged from .06 to .18. The highest correlations were for French. Graduating-class size had virtually no correlations with scores. Race had small positive correlations--between .11 and .15--with the scores, which indicates that whites scored higher than blacks. Sex also had positive correlations with scores. These correlations indicated that females scored higher than males. The correlations between sex and the scores were lower (.06, .07) for Sentence Structure and Grammar than they were for the other scores (.11 to .15).

In the first set of regression analyses, the total English Usage score was regressed on the grade for Grade 9 English and for whether English was taken in grades 10-12. This approach was chosen to reflect, as much as possible, the contribution of previous achievement and ability in English as separate from that of taking additional coursework. The results of these analyses are presented in Table 2.3 (page 2-10). Grades from Grade 9 English, with beta weights of .30 to .44, were the major contributors to prediction. Grade 12 English had beta weights of .04 to .06; the other grade levels did not enter the equations. Multiple Rs ranged from .31 to .44, but generally the equations for all scores were similar.

The next set of regressions, reported in Table 2.4 (page 2-10), used grades for each of the four years of English. Multiple Rs increased by four to six points, and the contributions of the various grade levels were more equal. For three of the subscores (Diction and Style, Grammar, and Punctuation) and the total English Usage score, the prediction pattern was similar. English 9, 10, and 11, with descending beta weights in that order, were included in the equation. Logic and Organization had relatively even beta weights for grades 9, 10, and 12 while Sentence Structure, which was predicted from grades in English 9 and 12 only, had the lowest multiple R (.35).

A correlation matrix of scores with English and Speech grades and semesters of foreign language was calculated using pairwise deletion. The regression results based on this matrix, which are shown in Table 2.5 (page 2-11), yielded a prediction pattern similar to the one in Table 2.4. The main difference was that the grades for English 11 did not enter any of the

equations. English 10 dropped from the prediction of the Logic and Organization score leaving only English 9 and 12, and English 9 dropped from the prediction of the Sentence Structure score leaving only English 12. Speech grades and semesters of foreign language did not enter the equations.

However, when grades for English 10-12 and Speech were replaced with whether or not those courses had been taken (leaving the English 9 Grade as a "covariate"), all of the foreign language variables entered and did so with moderate beta weights, especially so for French. Multiple Rs were slightly higher than in the prediction from English course grades alone except for the Diction and Style subscore. The only English variable to enter was the English 9 grade, and the prediction pattern was similar across subtests. Results are provided in Table 2.6 (page 2-11).

Adding race, sex, and graduating-class size to the previous analysis increased the multiple R by only one to two points. Sex and class size did not enter, but race had beta weights of .08 to .12. The basic prediction pattern remained similar, however. (See Table 2.7, page 2-12.)

Subgroup Analyses

Separate regressions of scores on English grades were done for sex and race groups. The regression equations for males (minimum pairwise N = 202) were based on only Grades 9 and 12 English grades while those for females (minimum pairwise N = 247) did not include Grade 12 English grades at all. As shown in Table 2.8 (page 2-13), the multiple correlations were generally comparable for males and females on Diction and Style, slightly more accurate for males on Sentence Structure and Logic and Organization, and slightly more accurate for females on Punctuation, Grammar, and total English Usage.

Results by race are presented in Table 2.9 (page 2-13). Unfortunately, with the exception of the Logic and Organization subscore, where the Grade 9 English grade had a beta weight of .40, prediction of scores from English course grades was indeterminant for blacks (minimum pairwise N = 23). None of the grades met the criteria for entry into the equations. This result is probably due to the small number of blacks in the analysis. For whites (minimum pairwise N = 426), prediction was about the same as in previous analyses with multiple Rs ranging from .34 to .50 and Grade 12 English grades entering only for Logic and Organization and Sentence Structure.

DISCUSSION

Perhaps the nonlinear nature of language teaching and learning needs to be addressed here. The metaphor some have used to describe the organic nature of language and the gradual, rather than incremental, process of its mastery is "a rising spiral of sophistication." Given the absence of a hierarchy of discrete skills, the idiosyncratic nature of language acquisition, and the powerful affective dimension of performance in the Language Arts, it is no wonder that literacy skills simply do not lend themselves to being parceled out by grade level. Language skills are acquired, developed, and applied iteratively: the contexts deepen in complexity at higher levels. It is within this context that the results of this study of the English Usage Test need to be viewed.

Course grades in English appear to contribute most to the prediction of the total English Usage score and the subtest scores when the equation includes the other courses taken. The Grade 9 English grade happened to be the variable that entered the equation first but, as shown by the simple correlations in Table 2.2, the grades in the other English courses would have served almost as well.

Even when compared with the grades in the other English courses, the grade for Grade 9 English still seems to predict best, though the grades for the other English courses also contribute to the prediction. The Grade 12 English grade may be contributing uniquely: it enters the equation only for Logic and Organization and for Sentence Structure. Since these content areas are considered more complex than the others, they are often emphasized in Grade 12 English, especially in college-preparatory classes.

Regression results for English course grades and semesters of foreign language indicated that English course grades alone suffice to predict the scores. However, when the English grade for Grade 9 as covariate is used with the other English courses taken and the semesters of foreign language taken, the foreign language taken helps the prediction even though the best predictor still appears to be the Grade 9 English grade. Interestingly enough, taking French appears to be somewhat more helpful than taking any other foreign language, even Spanish, which is a close second. Why is taking French more helpful than taking the other foreign languages in this study? Both French and Spanish share sentence word order comparable to that in English, which is not true for the highly inflected German. On those grounds, one would expect equal predictive power between French and German. Perhaps there is a selection effect being revealed: it may be that better performers in English courses are studying French as their foreign language, rather than Spanish or any other foreign language.

Regarding the contribution of demographic variables, it appears that while the size of the graduating class has no predictive influence, sex and race add something of interest to the configurations. English course grades predict test performance somewhat more accurately for females than for males. The Grades 9 and 12 English grades alone predict for males; in the case of Grade 12 English grades for males, the strongest relationship is found for Logic and Organization and Sentence Structure. This result might confirm the assumption that these two subjects receive special curricular emphasis in Grade 12 English courses. Then, too, the results may reflect the earlier maturity of females in the language areas. It seems possible, furthermore, that females are more conscientious students in each grade level than are males, who might be inclined to buckle down only in their last grade level, particularly if they are college bound. Thus for females the number of English courses would contribute more to the relationship than it does for males.

English course grades do not appear to contribute to the prediction of scores for black examinees in this study, except in the area of Logic and Organization. This is not a matter of black examinees doing poorly; we simply cannot predict scores for them on the basis of the self-reported grades. The problem probably resides in the small number of black examinees in our sample: N = 117. Furthermore, evidence abounds that grades themselves and self-reported grades especially may be unreliable. Further research may help in this regard as well as in that of clarifying the relationship between coursework and performance on the ACT Assessment.

Table 2.1

Descriptive Data for Variables

	N	Scale	Mean	SD
Scores				
English Usage	2271	0-75	47.38	11.99
Diction and Style	2271	0-13	8.42	2.91
Grammar	2271	0-19	9.58	3.35
Logic and Organization	2271	0-17	13.24	3.25
Punctuation	2271	0-12	7.26	2.36
Sentence Structure	2271	0-14	8.87	2.27
Courses Taken (0 = Not Taken, 1 = Taken)				
English 9	2271	0-1	1.00	.00
English 10	2271	0-1	1.00	.05
English 11	2271	0-1	.99	.10
English 12	2271	0-1	.90	.30
Speech	2271	0-1	.35	.48
Course Grades (1 = D, 2 = C, 3 = B, 4 = A, F excluded)				
English 9	2271	1-4	3.06	.80
English 10	2268	1-4	3.03	.79
English 11	2232	1-4	2.99	.81
English 12	466	1-4	3.15	.77
Speech	584	1-4	3.67	.69
Semesters of Foreign Language				
Spanish	2271	0-8	2.38	2.68
German	2271	0-8	.45	1.50
French	2271	0-8	1.75	2.59
Other FL	2271	0-8	.43	1.39
Demographics				
Race (1 = Black, 3 = White)	2271	1,3	2.90	.44
Sex (4 = Male, 6 = Female)	2271	4,6	5.17	.99
Graduating-class size[1]	2271	1-7	3.59	1.15

[1] Graduating-class size Code:
1 = Fewer than 25; 2 = 25-99; 3 = 100-199; 4 = 200-399; 5 = 400-599;
6 = 600-899; 7 = 900 or more.

Table 2.2

Correlation of Total and Subtest Scores with
Courses Taken, Course Grades, Semesters of Foreign Language,
and Demographics

Scores:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Courses Taken						
English 10	-.01	-.00	.00	-.02	.01	-.02
English 11	.02	-.01	.03	.03	-.00	.03
English 12	.09	.06	.08	.08	.08	.07
Speech	.07	.05	.07	.06	.06	.03
Course Grades						
English 9	.44	.41	.38	.40	.37	.31
English 10	.44	.40	.36	.40	.38	.31
English 11	.40	.36	.34	.36	.34	.28
English 12	.41	.35	.35	.41	.32	.32
Speech	.30	.24	.24	.28	.27	.22
Semesters Foreign Language						
Spanish	.08	.09	.06	.09	.07	.06
German	.06	.06	.06	.04	.07	.05
French	.18	.14	.17	.17	.13	.15
Other FL	.08	.06	.06	.06	.09	.08
Demographics						
Race	.15	.15	.11	.13	.11	.14
Sex	.12	.12	.07	.13	.12	. 06
Class size	.02	-.00	.02	-.01	.04	.03

Table 2.3

Regression Results for Total and Subtest Scores
on English 9 Grades and English 10-12 Courses Taken
(N = 2271)

Score for:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Beta Weights for:						
English 9 grades	.44	.40	.37	.39	.37	.30
English 10 taken	-	-	-	-	-	-
English 11 taken	-	-	-	-	-	-
English 12 taken	.06	.04	.06	.06	.06	.05
Multiple R	.44	.41	.38	.40	.37	.31

Table 2.4

Regression Results for Total and Subtest Scores
on Grades in English 9-12[1]

Score for:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Beta Weights for:						
English 9 grades	.24	.22	.21	.17	.19	.18
English 10 grades	.20	.20	.16	.16	.18	-
English 11 grades	.14	.12	.13	-	.13	-
English 12 grades	-	-	-	.19	-	.21
Multiple R	.50	.46	.42	.46	.43	.35

[1] Minimum Pairwise N = 449

Table 2.5

Regression Results for Total and Subtest Scores on Course Grades and Semesters of Foreign Language

Dependent Variable:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Beta Weights for:						
English 9 grades	.28	.25	.25	.24	.23	-
English 10 grades	.27	.25	.21	-	.24	-
English 11 grades	-	-	-	-	-	-
English 12 grades	-	-	-	.26	-	.32
Speech grades	-	-	-	-	-	-
SEM Spanish	-	-	-	-	-	-
SEM German	-	-	-	-	-	-
SEM French	-	-	-	-	-	-
SEM Other FL	-	-	-	-	-	-
Multiple R	.49	.45	.41	.45	.42	.32

[1] Minimum Pairwise N of Cases = 156.

Table 2.6

Regression Results on Total and Subtest Scores of Courses Taken, Semesters Foreign Language, and English 9 Grade as Covariate[1]

Dependent Variable:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Beta Weights for:						
English 9 grade	.37	.35	.32	.33	.32	.24
English 10 taken	-	-	-	-	-	-
English 11 taken	-	-	-	-	-	-
English 12 taken	-	-	-	-	-	-
Speech taken	-	-	-	-	-	-
SEM Spanish	.24	.19	.20	.24	.19	.21
SEM German	.15	.12	.13	.12	.13	.12
SEM French	.29	.21	.26	.28	.22	.27
SEM Other FL	.12	.09	.10	.11	.13	.13
Multiple R	.51	.44	.43	.46	.42	.38

[1] N of Cases = 2271

Table 2.7

Regression Results on Total and Subtest Scores of Courses Taken, Semesters Foreign Language, Demographics, and English 9 Grade as Covariate[1]

Dependent Variable:	English Usage	Diction & Style	Grammar	Logic & Organization	Punctuation	Sentence Structure
Beta Weights for:						
English 9 grade	.36	.34	.31	.32	.31	.23
English 10 taken	-	-	-	-.04	-	-
English 11 taken	-	-	-	-	-	-
English 12 taken	.04	-	.04	-	.04	-.04
Speech	-	-	-	-	-	-
SEM Spanish	.24	.20	.20	.24	.19	.22
SEM German	.14	.11	.13	.12	.13	.12
SEM French	.29	.22	.26	.28	.22	.27
SEM Other FL	.13	.09	.10	.11	.13	.13
Race	.12	.12	.08	.11	.08	.12
Sex	-	-	-	-	-	-
Graduating-class size	-	-	-	-	-	-
Multiple R	.52	.46	.44	.47	.43	.40

[1] N of Cases = 2271

Table 2.8

Regression Results for Total and Subtest Scores on English Course Grades for Males and Females (Minimum Pairwise N = 202 and 247, respectively)

Scores for:	English Usage		Diction & Style		Grammar		Logic & Organization		Punctuation		Sentence Structure	
Sex:	M	F	M	F	M	F	M	F	M	F	M	F
Beta Weight for Course Grade:												
English 9	.24	.21	.22	.23	.24	.19	.19	.21	.20	.23	.17	.17
English 10	-	.23	-	.28	-	.17	-	.28	-	.25	-	.21
English 11	-	.15	-	-	-	.16	-	-	-	-	-	-
English 12	.31	-	.28	-	.22	-	.33	-	.22	-	.23	-
Multiple R	.42	.51	.45	.45	.41	.44	.47	.43	.37	.43	.36	.34

Table 2.9

Regression Results for Total and Subtest Scores on English Course Grades for Blacks and Whites (Minimum Pairwise N = 23 and 426, respectively)

Scores for:	English Usage		Diction & Style		Grammar		Logic & Organization		Punctuation		Sentence Structure	
Race:	B	W	B	W	B	W	B	W	B	W	B	W
Beta Weight for Course Grade:												
English 9	.40	.23	-	.22	-	.20	.40	.17	-	.19	-	.17
English 10	-	.20	-	.19	-	.16	-	-	-	.18	-	-
English 11	-	.15	-	.12	-	.14	-	.16	-	.13	-	-
English 12	-	-	-	-	-	-	-	.20	-	-	-	.22
Multiple R	.40	.50	-	.46	-	.42	.40	.46	-	.43	-	.34

3. Mathematics Usage Courses and Scores

RESULTS

Data from 2,192 examinees with valid ACT Mathematics Usage Test (ACTM) scores were analyzed. Only those students who reported taking an Algebra II course--about 95%--were included in the study. ACTM is a 40-item, 50-minute test that reflects a sampling of mathematical techniques typically covered in high school courses. The test emphasizes the solution of practical, quantitative problems rather than memorization of formulas, knowledge of techniques, or computational skill. Six classifications of test items are included in the test and are described in Table 3.1. The item classifications were used to create subscores, not conventionally reported for the ACT Assessment, that were thought to be directly related to the content of specific high school courses. AAO and AAR items (18 items) were combined to create an Elementary Algebra subscore; all Geometry items (8 items) were considered together as a Geometry subscore; and IA items (8 items) were considered together as an Intermediate Algebra subscore. The four NNS items, and the two AT items were thought to be too few to create subscores and were not analyzed further.

Table 3.2 presents descriptive data for the variables analyzed. For this sample of college-bound high school seniors, the items generally were fairly challenging with subscore means of about 50% of the maximum possible score.

In terms of course taking, only those students who reported a course in Algebra I were considered in the analysis. Of those students, however, it can be seen from Table 3.2 that 84% of them went on to take Algebra II; 93% took Geometry; 43%, Trigonometry; 32%, Advanced Mathematics (other math beyond

Algebra II, but not Calculus or Trigonometry); and 11%, Beginning Calculus. Students who reported receiving an "F" in any of the above courses were treated as if they had not taken the course.

Mean grades for the students (Fs not included) were generally at the "B" level. It is interesting to note, however, that as the level of the course increases (e.g., from Algebra I and Geometry to Calculus), the mean reported course grades tend to increase. This is probably due to the self-selection of increasingly able students as they elect to take additional math courses during their high school careers.

In terms of further description, the sample was predominately white (95%) and female (58%), and the average size of the graduating class was in the range of 200-399 students.

Simple product-moment correlations of the total score and three subscores with courses taken, course grades, and background variables are presented in Table 3.3. Not surprisingly, the highest correlations were found for the course grades. Clearly, performance in the classroom has substantial influence on achievement test scores in mathematics. However, the magnitude of the correlations for courses taken (coded as 0,1) with test scores was somewhat of a surprise. Although these correlations should be interpreted cautiously because of the self-selection factor---the most able students will tend to take more mathematics---the data do suggest that the successful completion of relevant courses does seem to have a substantial influence on mathematics achievement test performance.

Although the correlations were small for the demographic variables of race, sex, and class size, these data suggest that a statistically significant relationship does exist between these variables and test scores. (The negative correlations for sex are due to the arbitrary coding used for the

variable.) These data are consistent with frequently reported results that whites score higher than blacks and males score higher than females on mathematics achievement tests in high school.

Stepwise regression results for course grades only are reported in Table 3.4. For all subscores as well as for the total score, grade in Geometry was the only variable to enter the equation. This is not to say that grades in other courses aren't related to test performance; it just implies that once one grade (Geometry in this case) is entered into the equation, other course grades do not add much. It may be that course grades in mathematics are largely measures of general mathematics ability or motivation to learn in the classroom and are not course-specific.

Table 3.5 summarizes the stepwise regression results for courses taken only. Since all the students used in the sample reported having taken Algebra I, Algebra I was not part of any of the equations. However, for each subscore as well as for the total ACTM score, all included course taking variables entered the equation. That is, information about whether or not each of the specific courses was taken added substantially to the multiple regression equation. Simply stated, these data suggest that the more mathematics taken in high school, the higher the expectation will be for student performance on the ACTM. In addition, it is noteworthy that course taking by itself was more predictive of test performance (multiple R of .64 for the total score) than was course grade performance (R of .53 for the total score--see Table 3.4).

The results reported in Table 3.5 for the subgroups were somewhat surprising in that courses that seemed most relevant to the particular subscores did not contribute most to their respective regression equations. In fact, the Beta weights for Geometry and Algebra II were actually the

smallest of the weights in the Geometry and Intermediate Algebra equations, respectively. For all the scores, the more advanced courses---trigonometry, advanced math, and calculus---contributed the most to the multiple Rs. This is probably due to the self-selection effect---the most able students took the advanced courses and the least able did not---rather than to the significance of Beginning Calculus course content, for example, to performance on elementary algebra items.

Table 3.6 presents the regression results for course taking when a course grade is added as a covariate. The analysis with the covariate was conducted so that the effects of taking specific courses could be examined in a context where mathematics ability is at least partially accounted for (by the covariate). Although among the included course grades, grade in Geometry correlated the highest with test performance, Algebra I grade was used as the covariate because all examinees in the sample had a grade for Algebra I.

As can be seen in Table 3.6, Algebra I grade is among the most influential variables, if not the most influential, for predicting the test scores. But consistent with the course taking only results in Table 3.5, with only one exception, all the variables contributed significantly to the prediction equation. Also consistent with Table 3.5 was the relative significance of the more advanced courses in each of the equations.

Notably from Table 3.6, with a multiple R of .68, almost half of the variance (46%) of total test score was accounted for. This is substantial. The fact that less variance was accounted for by the subscore regression equations is probably due primarily to the fewer items included in those subscores.

Table 3.7 presents the regression results for the data set with demographic/background variables added to courses taken and Algebra I grade.

Although sex entered into the equations for all scores, and race for three of the four, little additional variability was accounted for by the demographics.

Figure 3.1 illustrates a partitioning of the total score variance based on entry of the covariate first as a measure of ability or achievement prior to high school; courses taken, second; and the demographic variables, third. Of the variance accounted for, 24% was by Algebra I grade, 22% was from courses taken, and 3% was for the demographic variables. The remaining 51% was left to be explained by other factors and measurement error.

Finally, Table 3.8 presents regression analyses calculated for the total ACTM score, but separately for available subgroups: males, females, whites, and blacks. The most striking result in this table is the relative similarity of the regression equations. Multiple Rs for males, females, whites, and the total were all .68, whereas the multiple R for the black examinees (.64) differed only slightly. The Beta weights for the subgroups were also comparable, although they were somewhat more variable for the black group. It is conceivable that the black group equation may have appeared slightly different because of the relatively small sample size (N=104) that was available. Perhaps the Beta weights would have been more comparable to the others if more cases had been involved.

DISCUSSION

When interpreting the relative influence of mathematics course taking on ACTM test performance, it is important to recognize that students do not randomly elect to take certain courses. Typically there are course requirements for college-bound students. Not all students end up with the same courses, however. As can be seen in Table 3.2, most college-bound

students take Algebra I, Geometry, and Algebra II. Relatively fewer take more advanced mathematics courses. Thus, the more advanced courses tend to provide more variability for the regression equations.

It is also important to recognize that somewhat of a hierarchy exists for the investigated mathematics courses. Generally, the more advanced courses build upon skills learned in the earlier courses. For example, Algebra II builds upon Algebra I; Trigonometry, upon Geometry; Beginning Calculus, upon Algebra II and Trigonometry, etc. Consequently, a broader spectrum of students have Algebra I and Geometry in their backgrounds and a smaller, self-selected group report backgrounds in courses such as Calculus. Self-selection in terms of course taking contributes substantially to the strength of the multiple regression equation (R=.64) in predicting mathematics test performance simply from the student's transcript (see Table 3.5).

When Algebra I grade was allowed to enter the regression equation for courses only, the multiple R for all test scores increased. For the total ACTM score, the multiple R increased to .68 (Table 3.6). With the sample size of 2,192 cases, these results are quite stable. Cross-validation of the generated regression equation, on a randomly equivalent sample of students given a different form of the ACTM, yielded an R of .69. The fact that no shrinkage in the R occurred was a testament to the stability of the original regression equation. (The cross-validation R actually increased because examinee scores on the second form of the ACTM were slightly more variable than on the first form.)

Although it is well known that blacks and females score less well than whites and males, respectively, on the ACTM, the comparability of the regression equations (Table 3.8) suggests that the same variables are important for predicting the test performance of students in all studied

groups. It seems that regardless of whether a student is white or black, or male or female, test performance tends to be related to the number of relevant mathematics courses that are taken.

When performance in the classroom (measured here by Algebra I grade) is taken into account in addition to courses taken, almost half of the variance in total test score is accounted for. Given that many factors--other than relevant high school coursework and general mathematics ability--are likely to contribute to ACTM variability, this relationship is interpreted as a strong one. Factors such as student motivation, differential test familiarity, and measurement error account for the remaining 50% of the variance. With half of the variance accounted for by coursework and ability, and over 40% of the variability accounted for by coursework alone, it is clear that students with the most relevant coursework are likely to score the highest on the ACTM. Although this strong relationship does not, by itself, imply causation, reason suggests some degree of causation. As a general recommendation to students seeking to maximize their performance on the ACTM, it seems eminently reasonable, and consistent with this research, to advise them to take as many relevant courses in mathematics as possible.

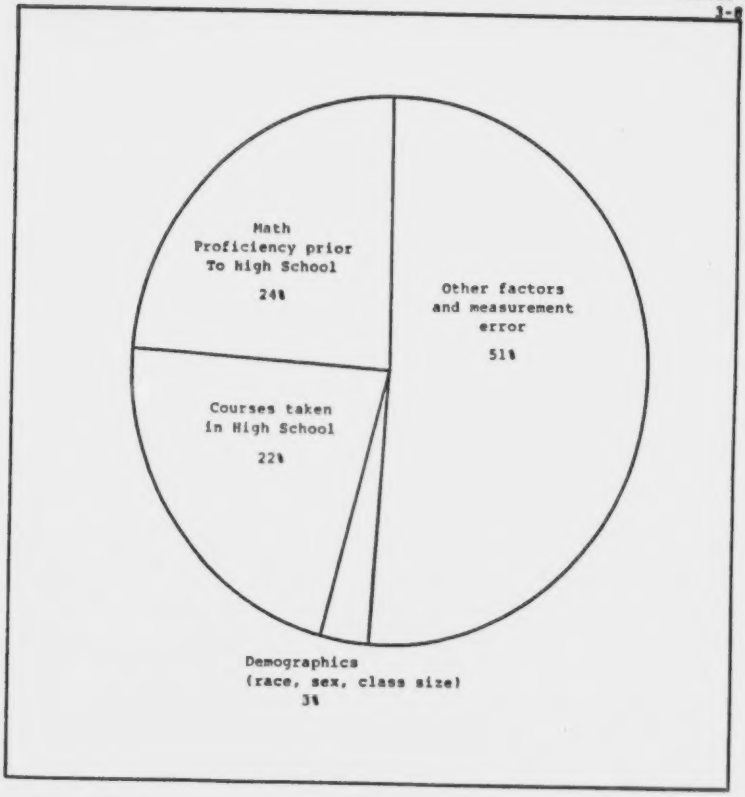


Figure 3.1 Estimated contributions of the studied variables to total ACTM score variance.

Table 3.1

ACTM Item Categories

Description	Example
1. Arithmetic and Algebraic Operations (AAO). The four items in this category explicitly describe operations to be performed by the student: manipulating and simplifying expressions containing arithmetic or algebraic fractions, performing basic operations in polynomials, solving linear equations in one unknown, and performing operations on signed numbers.	• $(2^{\frac{1}{3}})^{3} = ?$ A. $2^{\frac{1}{9}}$ D. $2^{\frac{4}{3}}$ B. 2^{7} E. 2^{64} * C. 2^{12}
2. Arithmetic and Algebraic Reasoning (AAR). The fourteen word problems in this category present practical situations in which algebraic and/or arithmetic reasoning is required. The problems require the student to interpret the question and to either solve the problem or find an approach to its solution.	• If 8 French francs were worth 1 U.S. dollar, and 2 U.S. dollars were worth 1 British pound, then 16 British pounds would be worth how many French Francs? * A. 256 D. 32 B. 128 E. 4 C. 64

Table 3.1-- continued

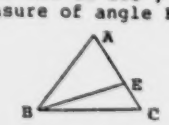
Description	Example
3. Geometry (G). The items in this category cover such topics as measurement of lines and plane surfaces, properties of polygons, the Pythagorean theorem, and relationships problems are included. Each form of the ACTM includes eight geometry items.	• In the figure below, $\overline{AB}$ and $\overline{AC}$ have the same length, and E lies on $\overline{AC}$. If the measure of angle ABC is 54° and the measure of angle BEC is 103°, what is the measure of angle EBC?  A. 18° D. 36° * B. 23° E. 49° C. 27°
4. Intermediate Algebra (IA). The eight items in this category include such topics as dependence and variation of quantities related by specific formulas, arithmetic and geometric series, simultaneous equations, inequalities, exponents, radicals, graphs of equations, and quadratic equations.	• What value of y satisfies the system of equations below? $2x + 3y = 5$ $x - 2y = 6$ A. -11 D. 2 * B. -1 E. 7 C. 1

Table 3.1-- continued

Description	Example
5. Number and Numeration Concepts (NNS). The four items in this category cover such topics as rational and irrational numbers, set priorities and operations, scientific notation, prime and composite numbers, numeration systems with bases other than 10, and absolute value.	• For all positive real numbers a, b, and c with $a = b + c$, which of the following inequalities is ALWAYS true? A. $a < b$ D. $ab < ac$ B. $b < c$ E. $a + b < a + c$ * C. $c < a$
6. Advanced Topics (AT). The items in this category cover such topics as trigonometric functions, permutations and combinations, probability, statistics, and logic. Only simple applications of the skills implied by these topics are tested. Each form of the ACTM includes two AT items.	• A 6-sided die with sides numbered 1 to 6 is tossed at the same time that a fair coin is flipped. A typical outcome is (5,H)--a 5 on the die and a head on the coin. How many different outcomes are possible? A. 8 D. 36 * B. 12 E. 64 C. 32

TABLE 3.2

Descriptive Statistics for Regression Variables
(N=2192)

Scores (raw scores)	Range	Mean	SD
Total Mathematics Usage	0-40	21.71	8.08
Elementary Algebra (AAO + AAR)	0-18	9.84	3.96
Geometry	0- 8	4.50	1.91
Intermediate Algebra	0- 8	3.51	1.83
Courses taken (0-1 coding[1])			
Algebra 1	0- 1	1.00[2]	.00
Algebra 2	0- 1	.84	.37
Geometry	0- 1	.93	.26
Trigonometry	0- 1	.43	.50
Advanced Math.	0- 1	.32	.47
Beginning Calculus	0- 1	.11	.31
Course Grades			
Algebra 1 (N = 2192)	0- 4.00	2.92	.91
Algebra 2 (N = 1647)	0- 4.00	2.88	.93
Geometry (N = 1939)	0- 4.00	2.82	.90
Trigonometry (N = 510)	0- 4.00	3.05	.89
Advanced Math. (N = 229)	0- 4.00	3.13	.85
Beginning Calculus (N = 42)	0- 4.00	3.41	.70
Demographics			
Race (1 = black; 3 = white)	1,3	2.91	.43
Sex (4 = male; 6 = female)	4,6	5.17	.99
Class Size (1 = <25....7= ≥900)	1-7	3.60	1.15

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[1] 0=Not taken; 1=Taken

[2] Only students with Algebra 1 in their backgrounds were included in the analysis.

TABLE 3.3

Simple Correlations

Variables	Scores			
	Total	Elem. Alg.	Geometry	Int. Alg.
Courses taken				
Algebra 2	.40[1]	.37	.30	.25
Geometry	.32	.29	.25	.21
Trigonometry	.45	.40	.35	.37
Advanced Math.	.36	.34	.30	.28
Beginning Calc.	.39	.36	.30	.36
Course grades				
Algebra 1	.49	.46	.35	.38
Algebra 2	.44	.41	.30	.34
Geometry	.53	.49	.40	.41
Trigonometry	.45	.44	.35	.33
Advanced Math.	.35	.31	.25	.29
Beginning Calc.	.44	.36	.37	.25
Demographics				
Race	.12	.11	.09	.04
Sex	-.17	-.15	-.18	-.13
Class Size	.10	.09	.06	.06

[1] Values of .06 or greater are significant at the .001 level.

TABLE 3.4

Total Sample Regression Results:

Course Grades[1]
(N=2191)

	Scores			
	Total	Elem. Alg.	Geometry	Int. Alg.
Beta Weights				
Algebra 2	---	---	---	---
Geometry	.53	.49	.40	.41
Trigonometry	---	---	---	---
Advanced Math.	---	---	---	---
Beginning Calc.	---	---	---	---
Multiple R_2	.53	.49	.40	.41
R^2	.28	.24	.16	.17

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[1] Stepwise regression was used. Variables without reported beta weights did not meet the criteria for inclusion in the equation.

TABLE 3.5

Total Sample Regression Results:

Courses Taken[1]
(N=2192)

	Scores			
	Total	Elem. Alg.	Geometry	Int. Alg.
Beta Weights				
Algebra 2	.18	.18	.12	.07
Geometry	.14	.12	.11	.08
Trigonometry	.24	.20	.19	.22
Advanced Math.	.22	.22	.20	.18
Beginning Calc.	.26	.24	.20	.26
Multiple R_2	.64	.58	.50	.51
R^2	.40	.34	.25	.26

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[1] Stepwise regression was used. All variables met the criteria for entry and remaining in the equation.

TABLE 3.6

Total Sample Regression Results:
Courses Taken with Algebra 1 Grade as Covariate[1]
(N=2192)

	Scores			
	Total	Elem. Alg.	Geometry	Int. Alg.
Beta Weights				
Algebra 2	.14	.14	.10	---
Geometry	.12	.10	.10	.08
Trigonometry	.18	.15	.15	.19
Advanced Math.	.19	.18	.18	.15
Beginning Calc.	.22	.21	.17	.23
Covariate (Alg. 1 grade)	.26	.25	.17	.21
Multiple R	.68	.62	.52	.54
R^2	.46	.39	.27	.29

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[1] Stepwise regression was used. Variables without reported beta weights did not meet the criterion for inclusion in the equation.

TABLE 3.7

Total Sample Regression Results:
Courses Taken, Demographics, and Algebra 1 Grade as Covariate[1]
(N=2192)

	Scores			
	Tota	Elem. Alg.	Geometry	Int. Alg.
Beta Weights				
Algebra 2	.13	.13	.09	---
Geometry	.11	.10	.09	.08
Trigonometry	.17	.14	.14	.18
Advanced Math.	.18	.17	.17	.15
Beginning Calc.	.21	.20	.16	.22
Race	.11	.09	.08	---
Sex	-.12	-.10	-.14	-.08
Class Size	.04	---	---	---
Covariate (Alg. 1 Grade)	.27	.26	.18	.21
Multiple R_2	.70	.64	.54	.54
R^2	.49	.41	.29	.29

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[1] Stepwise regression was used. Variables without reported beta weights did not meet the criterion for inclusion in the equation.

TABLE 3.8

Subgroup Regression Results:
Total Score Predicted by Courses Taken with Algebra 1 Grade as Covariate

Subgroup	N	R	R^2	A2	GEO	TRIG	ADV.M	BC	A1 GRADE
Males	912	.68	.46	.10	.12	.22	.17	.21	.29
Females	1280	.68	.46	.16	.12	.15	.20	.22	.27
Whites	2088	.68	.47	.13	.12	.19	.19	.22	.27
Blacks	104	.64	.41	.20	.14	.13	.09	.32	.17
Total	2192	.68	.46	.14	.12	.18	.19	.22	.26

Course Taking
5-18

4. Social Studies Reading

A total of 2,336 examinees had scores for the Social Studies Reading Test. The fifty-two items on this test covered Economics, Government, History, Psychology and Sociology. The exact number of items from each subject category varies from one form of the test to another. For this form, there were eleven Economics items, fourteen Government items, fifteen History items, ten Psychology items, and one Sociology item. Subtest scores were therefore created for each of the subject areas except Sociology.

These scores were generated especially for this study; they are not used on the ACT Assessment. Average percent correct scores were 55% for the Social Studies Reading total score, 54% for Economics, 43% for Government, 63% for History and 61% for Psychology.

Data were available for each of the examinees on whether or not they had taken each of the seven social studies-related courses listed in the high school-course/grade information section. Percentages of students reporting having taken these courses ranged from a high of 97% for U.S. History to a low of 19% for Geography. Self-reported grades were available only for those courses that had been completed, so the N's for course grades varied considerably. The average grade reported was just above a B. This was somewhat inflated, however, because students who reported receiving a grade of "F" in a course were treated as if they had not taken that course. That is, they were excluded from the analysis.

The analyses used four background variables: race, sex, high school grade-point average, and graduating-class size. The sample included 972 males and 1,364 females. There were 117 blacks and 2,219 whites; other racial groups had too few representatives for separate analysis. The high school grade-point average and graduating-class size were each reported on a scale of

1-7. The average GPA reported was about a B; the average graduating class size was about 200. Descriptive data for the variables used in these analyses are provided in Table 4.1 (page 4-11).

Correlations of the total and subtest scores with the courses taken, course grades, and demographic variables are reported in Table 4.2 (page 4-12). Except for correlations with grades, either for individual courses or for high school average, most correlations were very small (less than .10). Correlations with grades were mostly in the .2 to .3 range, the highest (.457) being between the total Social Studies Reading score and high school grade-point average.

The first regressions performed were of scores on course grades. Results of these analyses are reported in Table 4.3 (page 4-13). In each equation, a single course grade entered, possibly because of collinearity. Multiple Rs ranged from .31 to .39 (R^2 = .10 to .15). The course that entered was in the same subject area as the score for Government and History; however, the Economics grade entered for the Psychology score and vice versa.

The second set of equations regressed the total score and subscores on courses taken (courses coded as taken or not taken). Results are reported in Table 4.4 (page 4-13). No variable entered for the Psychology score. For the other equations, multiple Rs were between .07 and .12 with beta weights from .04 to .07. The Economics and Other History courses entered the Economics, History, and Social Studies equations; World History entered the History, Government, and Social Studies equations; and U.S. History entered the Government and History equations. Government, Geography, and Psychology courses did not enter any equations.

Adding high school grade-point average left the pattern of beta weights virtually unchanged. In fact, the only difference in course betas was that U.S. History did not enter the equation for the Government score. What the

H.S. GPA did do was to increase the multiple R substantially. Both beta weights for H.S. GPA and multiple Rs ranged from .32 to .46. No multiple R was more than .02 greater than the beta weight for high school GPA for that equation. Results are presented in Table 4.5 (page 4-14).

When sex, race, and graduating-class size were added to the equation (See Table 4.6, page 4-15), the multiple R increased from one to four points, but the beta weight pattern remained the same. Graduating-class size did not enter any of the equations. Race had small betas (.06 to .08) for all but the History equation, where it did not enter. Sex had betas of -.15 to -.17 for all of the equations except Psychology, where it did not enter.

Social Studies

Only one of the courses had a significant beta when the total Social Studies score was regressed on the set of course grades. The grade in that course, Economics, correlated .39 with the Social Studies score (multiple R = .39). The pairwise N for this correlation was 270, just over 11% of the sample. Zero-order correlations of grades in other courses with the Social Studies score ranged from .35 to .38.

The same regression using an indicator of whether the course was taken in place of the grade yielded very different results. The two courses taken by the largest percentages of students, U.S. History and Government, did not enter the equation. World History, Other History, and Economics entered with beta weights of .04 to .06 and a total multiple R of only .09. Adding the high school grade-point average to this equation raised the multiple R to .46 while retaining the same three courses with slightly reduced beta weights. H.S. GPA had a beta weight of .46.

The addition of sex, race, and size of the graduating class increased the multiple R by only three percentage points, to .50. Sex loaded negatively (indicating that males scored higher) and race positively (indicating that

whites scored higher). Class size did not contribute while the same three courses continued to provide a small (.04 to .05) contribution, and H.S. GPA continued to provide most of the predictive power (beta = .47).

Economics

Regressing Economics on the set of course grades also resulted in a single variable solution. In this case, the Psychology grade was the best single predictor with a multiple R of .33 (the Economics grade correlated .30 with the Economics score). Again, small sample sizes (Economics had been taken by only 11% of the students) and collinearity were clearly a factor.

Substituting course taking for course grades reduced the multiple R to .09, which was based on contributions from Other History (beta = .05) and Economics (beta = .06). Adding the H.S. GPA resulted in an increase of the multiple R to .37 (H.S. GPA had a beta weight of .36) The beta weights for course taking remained the same.

The addition of sex, race, and graduating-class size to the equation raised the multiple R by .04, to .41. Class size did not contribute. Race had a beta weight of .06 (whites higher) and sex a beta weight of -.17 (males higher).

Government

The course grade in Government was the single best predictor of the Government subscore (multiple R = .31). As in previous analyses, the multiple R dropped significantly (to .07) when course taking was substituted for course grades. Even though U.S. History had been taken by more than 93% of the students, that and World History entered the equation with beta weights of .04 and .05, respectively. Government did not contribute.

When H.S. GPA was added, U.S. History dropped out and the multiple R climbed to .34. The further addition of the sex, race, and class-size data raised the multiple R to .38 (an increase of .04). World History was retained, race (beta = .08) and sex (beta = -.15) contributed somewhat, and the main predictive power remained with H.S. GPA (beta = .35).

History

Among the course grades, the U.S. History grade was the best single predictor of the History score; it correlated .31. Using course taking in place of grades resulted in four courses (U.S. History, World History, Other History, and Economics) loading with betas of .05, .07, .05, and .05 respectively. The resulting multiple R was .12.

Adding H.S. GPA retained these four courses with slightly reduced betas and raised the R^2 to .41. The addition of race, sex, and class size raised the multiple R only 3 more points, to .44. Race and class size did not enter; sex had a beta weight of -.17.

Psychology

Psychology had been taken by only 11% of the students (the same percentage as Economics). The single best predictor of the Psychology score was the Economics grade (multiple R = .34); the Psychology grade correlated .23 with the Psychology score.

When course taking was substituted for course grades, no variable met the criteria to enter the equation. Adding H.S. GPA resulted in it serving as the single predictor with a multiple R of .32. Adding race, sex, and class size raised the multiple R by only one point, to .33. Neither sex nor class size contributed, while race had a beta weight of .07.

Subgroup Analyses

Separate regression analyses were run for the Social Studies total score and each of the subscores on courses taken and the high school grade-point average for sex (male and female) and race (black and white) groups of examinees. The purpose of these analyses was to determine whether different predictive patterns were operating for the different subgroups. Results are presented by sex in Table 4.7 (page 4-16) and by race in Table 4.8 (page 4-16).

Overall explanatory power was lower for male than female examinees on the total Social Studies score and each of the subscores. As in previous analyses, the majority of the predictive power was lodged in the H.S. GPA (betas of .31 - .50). In fact, H.S. GPA was the sole predictor for females in Social Studies and in Government, and for both sexes in Psychology.

Other History made a small contribution to the Social Studies and Economics prediction for males and World History did so for females. Economics course-taking had a small significant beta weight for Government for females for the Economics score, while U.S. History, World History and Other History contributed to prediction of the History subscore for females. All of these contributions were small, with betas ranging from .05 to .08.

Prediction was more accurate for whites than for blacks for all of the scores. Prediction for blacks was exclusively based on the high school GPA (betas of .20 to .36) except for Government where Other History entered the equation with a beta of .19, the largest beta observed in this study for the taking of any course. Course-taking information improved predictive accuracy for whites for all scores except the Psychology score. Economics entered the equations for Social Studies, Economics, and History; World History entered

the equations for Social Studies, Government, and History; Other History entered the equations for Economics and History; and U.S. History entered the equation for History. All betas for course taking were between .04 and .06.

Cross-validation

The regression of total Studies Score on High School GPA and courses taken from Table 4.5 was chosen for cross-validation. The original equation had a multiple R of .46 based on an N of 2336. The cross validation, based on an N of 2232 from a parallel form, also had a multiple R of .46; that is, there was no shrinkage.

Discussion

Regression analysis of the total Social Studies Reading score on course taking, demographics, and high school grade-point average showed clearly that the strongest predictor of the test score was the H.S. GPA. This is not surprising for a number of reasons. The GPA represents a complex of factors including academic ability, previous academic performance, and motivation--to name a few. Since reading is a critical skill in many high school courses, not just those in the Social Studies, it is likely that GPA would correlate highly with most measures of reading skills.

Over and above the GPA contribution, however, taking courses in History and Economics generally appears helpful. Courses in Geography, Government, and Psychology do not appear to improve scores, despite the inclusion of both Government- and Psychology-oriented materials in the test. The contribution of specific courses does not always appear to be subject-specific. Economics and History coursework contributed to performance both in their own and each

others' areas and in Government. This may reflect the influence of increasing skills in reading materials in the Social Sciences as well as increasing subject-specific information.

Prediction was somewhat more accurate for whites and females than for blacks and males. The best predicted subscore was generally History, with all three History courses contributing. The Psychology subscore appeared predictable only from GPA and sex. It may be that science coursework would have predicted the Psychology score better than did the Social Studies coursework.

Conclusions

In summary, this study suggests the following:

1. Grades received in Social Studies courses are more predictive of the Social Studies Reading score than is simply taking the course.

2. Taking History and Economics courses is generally predictive of Social Studies scores; taking Government, Geography or Psychology courses generally is not.

3. Even when high school GPA is taken into account, taking History and Economics improves Social Studies scores.

4. Males score higher than females in every Social Studies area except Psychology where there was no difference, but prediction was more accurate for females.

5. Whites scored higher than blacks in every Social Studies area except History. Prediction was more accurate for whites than blacks except for the History subscore.

6. Prediction of the Social Studies score on high school GPA and taking Social Studies courses accounted for about 21% of the variance and cross-validation without shrinkage.

Although this study did not include consideration of the number of Social Studies courses taken, it seems likely that predictive accuracy would be improved by the inclusion of that information. Future research would probably benefit from more detailed data on the instructional experience of the student: subject content covered, level of mastery, and recency of instruction are all topics on which additional specificity might be expected to improve the accuracy of prediction.

Overall, the best prediction systems were able to account for about 25% of the variance in scores. Considering that the grades were self-reported and came from multiple schools with unknown grading standards, that the content of the named courses was neither consistent nor known, and that no information relating to the quality of instruction was available, that level of predictive accuracy may be about as good as could be expected.

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Table 4.1

Descriptive Data for
Variables

	N	Scale	Mean	SD
Scores				
Social Studies Reading	2336	0-52	28.65	7.96
Economics	2336	0-11	5.91	2.33
Government	2336	0-14	6.08	2.92
History	2336	0-15	9.46	2.87
Psychology	2336	0-10	6.09	1.90
Courses (0 = Not Taken, 1 = Taken)				
U.S. History	2336	0-1	.97	.17
World History	2336	0-1	.69	.46
Other History	2336	0-1	.20	.40
Government	2336	0-1	.84	.37
Economics	2336	0-1	.26	.44
Geography	2336	0-1	.19	.39
Psychology	2336	0-1	.26	.44
Course Grades (1 = D, 2 = C, 3 = B, 4 = A, F excluded)				
U.S. History	2198	1-4	3.10	.84
World History	1516	1-4	3.09	.84
Other History	377	1-4	3.16	.79
Government	668	1-4	3.21	.79
Economics	270	1-4	3.22	.81
Geography	408	1-4	3.24	.82
Psychology	263	1-4	3.23	.78
Demographics				
Race (1 = black, 3 = white)	2336	1,3	2.90	.44
Sex (4 = male, 6 = female)	2336	4,6	5.17	.99
GPA[1]	2336	1-7	5.41	1.22
Graduating Class size[2]	2336	1-7	3.60	1.15

Code	[1]GPA	[2]Class-size
1	D- to D (0.5 - 0.9)	fewer than 25
2	D to C- (1.0 - 1.4)	25 - 99
3	C- to C (1.5 - 1.9)	100 - 199
4	C to B- (2.0 - 2.4)	200 - 399
5	B- to B (2.5 - 2.9)	400 - 599
6	B to B+ (3.0 - 3.4)	600 - 899
7	A- to A (3.5 - 4.0)	900 or more

Table 4.2

Correlations of Scores with
Courses Taken, Course Grades and Demographics

Scores:	Social Studies	Economics	Government	History	Psychology
Courses Taken[1]					
U.S. History	.049	.016	.047	.060	.030
World History	.060	.036	.058	.075	.007
Other History	.046	.053	.024	.057	.013
Government	.031	.012	.038	.012	.025
Economics	.055	.060	.035	.052	.022
Geography	-.042	-.049	-.021	-.031	-.027
Psychology	-.025	-.033	-.038	-.013	.017
Course Grades[2]					
U.S. History	.376	.272	.293	.351	.234
World History	.365	.271	.272	.344	.242
Other History	.347	.255	.297	.294	.186
Government	.383	.310	.309	.350	.247
Economics	.386	.304	.295	.305	.335
Geography	.281	.201	.243	.280	.115
Psychology	.380	.328	.302	.300	.231
Demographics[1]					
Race	.113	.089	.108	.056	.100
Sex	-.108	-.124	-.108	-.124	.052
High School GPA	.457	.358	.338	.394	.318
Class size	.017	.032	-.018	.022	.015

[1] N = 2336
[2] Minimum pairwise N = 40

Table 4.3

Regression Results Using Course Grades[1]

Dependent Variable:	Social Studies	Economics	Government	History	Psychology
Beta Weights for Course Grades[2]					
U.S. History	-	-	-	.35	-
World History	-	-	-	-	-
Other History	-	-	-	-	-
Government	-	-	.31	-	-
Economics	.39	-	-	-	.34
Geography	-	-	-	-	-
Psychology	-	.33	-	-	-
Multiple R	.39	.33	.31	.31	.34

[1] F to enter was 3.84; variables without reported beta weights did not enter.

[2] Pairwise deletion, minimum pairwise N = 40

Table 4.4

Regression Results
Courses Taken[1]
(N = 2353)

Dependent Variable:	Social Studies	Economics	Government	History	Psychology[2]
Beta Weights for courses taken					
U.S. History	-	-	.04	.05	-
World History	.06	-	.05	.07	-
Other History	.04	.05	-	.05	-
Government	-	-	-	-	-
Economics	.05	.06	-	.05	-
Geography	-	-	-	-	-
Psychology	-	-	-	-	-
Multiple R	.09	.09	.07	.12	-

[1] F to enter was 3.84; variables without reported beta weights did not enter.

[2] No variables met the criterion to enter when the Psychology subscore was dependent.

Table 4.5

Regression Results for
Courses Taken and H.S. GPA[1]
(N = 2336)

Dependent Variable:	Social Studies	Economics	Government	History	Psychology[2]
Beta Weights for courses taken					
U.S. History	-	-	-	04	-
World History	.05	-	.05	.06	-
Other History	.04	.05	-	.05	-
Government	-	-	-	-	-
Economics	.05	.06	-	.05	-
Geography	-	-	-	-	-
Psychology	-	-	-	-	-
Beta Weight for High School Grade Point Average					
GPA	.46	.36	.34	.39	.32
Multiple R	.46	.37	.34	.41	.32

[1] F to enter was 3.84; variables without reported beta weights did not enter.

[2] No variables met the criterion to enter when the Psychology subscore was dependent

Table 4.6

Regression Results for
Courses Taken and Demographics and Grade Point Average[1]
(N = 2336)

Dependent Variable:	Social Studies	Economics	Government	History	Psychology
Beta Weights for courses taken					
U.S. History	-	-	-	.04	-
World History	.04	-	.04	.05	-
Other History	.04	.05	-	.05	-
Government	-	-	-	-	-
Economics	.04	.05	-	.04	-
Geography	-	-	-	-	-
Psychology	-	-	-	-	-
Beta Weights for High School Grade Point Average					
GPA	.47	.38	.35	.42	.31
Beta Weights for Demographics					
Sex	-.17	-.17	-.15	-.17	-
Race	.07	.06	.08	-	.07
Graduating class size	-	-	-	-	-
Multiple R	.50	.41	.38	.44	.33

[1] F to enter was 3.84; variables without reported beta weights did not enter.

Table 4.7

Beta Weights for Regression of Scores
on Courses Taken and H.S. GPA for Male and Female Examinees
(N = 972 and 1369, respectively)

Score for: Course Taken	Social Studies M	Social Studies F	Economics M	Economics F	Government M	Government F	History M	History F	Psychology M	Psychology F
U.S. History	-	-	-	-	-	-	-	.05	-	-
World History	-	-	-	-	.06	-	-	.06	-	-
Other History	.06	-	.08	-	-	-	.06	.05	-	-
Government	-	-	-	-	-	-	-	-	-	-
Economics	-	-	-	.05	-	-	-	-	-	-
Geography	-	-	-	-	-	-	-	-	-	-
H.S. GPA	.45	.50	.34	.41	.35	.37	.40	.43	.31	.32
Multiple R	.46	.50	.35	.41	.35	.37	.40	.44	.31	.32

Table 4.8

Beta Weights for Regression of Scores on
Courses Taken and H.S. GPA for Black and White Examinees
(N = 117 and 2219, respectively)

Score for: Course Taken	Social Studies B	Social Studies W	Economics B	Economics W	Government B	Government W	History B	History W	Psychology B	Psychology W
U.S. History	-	-	-	-	-	-	-	.04	-	-
World History	-	.05	-	-	-	.06	-	.06	-	-
Other History	-	-	-	.05	.19	-	-	.05	-	-
Government	-	-	-	-	-	-	-	-	-	-
Economics	-	.05	-	.06	-	-	-	.05	-	-
Geography	-	-	-	-	-	-	-	-	-	-
Psychology	-	-	-	-	-	-	-	-	-	-
H.S. GPA	.36	.46	.31	.35	.31	.33	.32	.39	.20	.32
Multiple R	.36	.46	.31	.36	.38	.33	.32	.41	.20	.32

5. Science Courses and Scores

RESULTS

Descriptive data

A total of 2,353 examinees obtained scores on the Natural Sciences Reading (NSR) Test. (As a result of listwise deletion, the final number of examinees whose data was used for this study was 2,337). The 52 items on this test included items on Chemistry, Biology, General Science, and Physics. The precise number of items from each of these contents varies from test form to test form. On this particular form, there were 13 Chemistry items, 15 Biology items, 11 General Science items, and 13 Physics items. Subscores, not conventionally reported for the ACT Assessment, were artificially created for each of the four content areas for the purposes of this study.

Table 5.1 (page 5-10) presents descriptive data for the regression variables used in the different regression equations. Scores in general tended to be low, averaging less than 50% of the items correct in any category. Courses taken proved to have interesting results. When a variable has a value of 0 or 1, the mean of that variable may be interpreted as a percent. In this instance, the value presented is the percent of the sample taking the course listed. The course most commonly taken by the sample was Biology (92%), followed by Chemistry (74%), General Science (71%), and Physics (35%). It is conceivable that, due to the way the Student Profile Section (SPS) is designed, more students took General Science than show here. Those students who took General Science in junior high would not be counted here, because the SPS focuses on high school coursework only. The large number of students taking Chemistry compared to those taking Physics was not entirely unexpected because, though the sample consisted entirely of seniors, many of

them were more likely to have completed Chemistry as juniors, prior to taking Physics (which could not be reported at the time of test administration as being a completed course) as seniors.

The sample was predominantly white (95%) and female (58%). The mean GPA was 5.41 on a scale of 1-7, where 1 = D to D- and 7 = A to A-, indicating that the sample had an overall GPA of about a B. Course grades in science were consistent with the overall GPA: around a B- to B+. Students who reported receiving an "F" in a science course were treated as if they had not taken the course and were excluded from the analysis.

Zero-order correlations

Table 5.2 (page 5-11) presents the zero-order correlations between the independent and dependent variables. None of the course grades correlated as well with their similarly named score counterpart as did Biology grades with the Biology subscore. Biology grades correlated better with Biology than they did with Chemistry and General Science, but equally well with Physics as with Biology. Higher correlations between course grades and NSR, the total score, would be expected because of the increased number of items involved.

Courses taken correlated quite differentially with subscores and NSR. General Science had a slight negative correlation with all scores, Biology had a slight positive correlation; the correlations continued to increase with, presumably, each successive course students take (Biology, then Chemistry, then Physics).

Of the demographics, sex correlated slightly negatively with the score, and race correlated slightly positively. The correlation of class size with the scores was negligible.

Overall GPA correlated most highly of any of the independent variables with the scores, with the highest correlation being between GPA and NSR.

Courses taken

In Table 5.3 (page 5-12) are summarized the regression results for courses taken. Consistently across all scores Chemistry and Physics were the only significant independent variables. Chemistry beta weights were highest when explaining the Chemistry subscore compared to Chemistry beta weights with other subscores. The Physics beta weights were higher when explaining the variance in the Physics subscore than Physics beta weights with other subscores. The beta weights for both Physics and Chemistry were highest when explaining NSR variance. The multiple R for NSR was .46, explaining about 21% of the variance.

Courses taken and GPA

In Table 5.4 (page 5-13) appear the regression results for courses taken and GPA. The GPA was introduced into the equation as a covariate, functioning as a common index of ability across the variables. With the effects of ability entered into the regression equation, Physics and Chemistry continued the same pattern as in Table 5.3 across all subscores and NSR. The difference in R^2 from the equation for Table 5.3 (R^2 = .21) versus that for Table 5.4 (R^2 = .30) was about .09.

Courses taken, demographics, and GPA

Table 5.5 (page 5-14) presents regression results for courses taken, demographics, and GPA. The pattern of course-to-score relationships established in Tables 5.3 and 5.4 changes somewhat. Chemistry and Physics continue to predominate as significant independent variables except with the Biology subscore, where having taken Biology now has some impact. The relative weights of Chemistry and Physics as significant contributions to General Science change in magnitude from the earlier tables. In Tables 5.3

and 5.4 Physics weighs more heavily as an independent variable than Chemistry, while in Table 5.5 the reverse is true.

Sex was weighted negatively in the equations for all but Chemistry, where it made no significant contribution. Race had a slight positive weight in all the equations. Class size did not prove to be an effective independent variable.

Overall GPA again proved to be the most effective independent variable with all subscores and NSR. There was some deviation from previously reported patterns in that the weight of GPA, when entered into the Chemistry subscore regression equation, remained constant with the introduction of the demographic variables. All other equations with GPA produced an increase in the weight of GPA.

Course grades

Table 5.6 (page 5-15) summarizes regression results using course grades as independent variables. General Science and Biology entered most frequently, with Physics also making a contribution to one score, Biology. The multiple R attained by using grades was .42 on NSR, the smallest amount of variation explained by any of the models.

Subgroup regression equations

Tables 5.7 and 5.8 (pages 5-16 and 5-17) present regression equations of courses taken and GPA on the four science subscores and NSR by sex and by race. Across all groups, Chemistry and Physics entered most consistently. The size of the multiple R for the sexes was quite comparable (R_F = .56, R_M = .55). The multiple R for race was more discrepant, with R_W = .55 and R_B = .48. Some seeming anomalies appear in Table 5.8, when having taken General Science for blacks was negatively weighted in the regression using the Physics

subscore. Also, GPA did not enter into the General Science equation for blacks. It is conceivable that this deviation may be attributable to the small number of blacks in the study. Further analysis would be warranted to pursue these issues.

Table 5.9 (page 5-18) is a summary of the regression equations on NSR for the total group, males, females, blacks, and whites. For whites, Physics entered into the equation, while for blacks it did not. Overall GPA was weighted less heavily for blacks than whites. Overall GPA was weighted more heavily for females than for males.

Using the regression equation for the total group for course taken and GPA on NSR, a cross-validation was performed on a parallel form of the test administered concurrently to a comparable group. The resulting R for the cross-validation was .54 compared with the R = .55 for the original group.

Chemistry

For this subscore, the least powerful of the regression models proved to be that using course grades, with a multiple R of .26, and General Science as sole effective independent variable. The model using courses taken increased the multiple R to .33, but entered Chemistry and Physics as independent variables. The addition of high school GPA, the strongest independent variable in that model, increased the multiple R to .38. Finally, the addition of the demographic variables contributed enough to raise the multiple R to .39.

Biology

The least powerful of the regression models for Biology was the equation using courses taken only. The only variables entering were Chemistry and Physics, with a multiple R of .33. The next most effective model was that

using course grades. Both Biology and Chemistry entered and the multiple R increased to .38. The addition of high school GPA to courses taken produced an increase of .09 in the multiple R, for a new total of .42. Chemistry, Physics, and GPA all entered as independent variables. Adding demographics, especially sex and race, contributed to a .02 increase in the multiple R, for a maximum of .44.

General Science

Course grades proved to be the least effective independent variable for General Science. Only Biology entered into the equation, for a multiple R = .24. The model with courses taken only produced a multiple R = .29, with Chemistry and Physics entering the equation. The addition of high school GPA, the most effective variable in this model, increased the multiple R to .36, with Chemistry and Physics continuing as the courses taken that had the most impact. Sex and race, when added to the model, produced a multiple R = .40, with Physics and Chemistry continuing as sole courses taken entered.

Physics

The least effective model for Physics was that of course grades, in which only Biology entered and the multiple R was .32. The use of the courses-taken model produced a multiple R of .40, with Chemistry and Physics entering as effective variables. The addition of GPA increased the multiple R to .46, and the further contributions of race and sex raised it to .49.

Natural Science Reading

Each of the four models of course grades, courses taken only, courses taken and high school GPA, and course taken plus GPA and demographics, successively proved to be more effective than the previous model at explaining NSR variance. The progression starts with a multiple R of .42 with course

grades and peaks at a multiple R of .58 for courses taken, GPA, and demographics. As with many of the subscores, the most effective course grades were those for General Science and Biology. For the other models, the most effective variables were Chemistry and Physics (courses taken), also true of the subscores.

DISCUSSION

Courses Taken

Two facts about science courses are necessary to the consideration of the data from this study. First, the nature of science courses is relatively hierarchical, that is, each builds on skills developed in the preceding course. Second, the majority of students in high school are required to take at least a general science and a biology course. As a result, it is not surprising that regression equations containing courses taken as independent variables would consistently produce significance for Chemistry and Physics. These two courses are usually taken in the latter years of high school and tend to be preceded in time by Biology and General Science. In addition, fewer students take Chemistry and Physics, providing more variability for the regression equations.

Course grades

The use of course grades as independent variables introduced greater variability with respect to the impact of courses on the equations. As a result, Biology became the most effective independent variable across all scores except Chemistry, where the grade for General Science was the sole variable to enter. The Physics grade also seemed to impact the Biology subscore. In fact, the combined effects of the Biology and Physics grades helped explain more variation in the Biology subscore than did any other set

of independent variables for any subscore. It is possible that a larger number of items included in the Biology subscore added just enough variability to the equation to permit more, effective independent variables. Certainly the zero-order correlations between each course grade and the Biology subscore parallel the results of the regression equations, in that Biology and Physics correlate more highly with the Biology subscore than do other course grades. The impact of the Biology grade would be expected; the effect of the Physics grade is not as clear.

Demographics

Sex proved to be negatively correlated with all scores. In other words, females tended to perform less well on all subtests and NSR. A comparison of the regression equations by sex indicates a greater impact of GPA for females than males, but lesser impact of specific courses taken. The value of the constant for females is lower than that for males. Though these results are not inconsistent with data from many gender-bias studies, further investigation into this effort is warranted.

Race had a slight positive correlation with all scores, indicating that whites tended to score better on all subtests and NSR. A review of the subgroup regression equations indicates that GPA weighed more heavily with whites, and that both Chemistry and Physics courses entered into the equation for whites, while only Chemistry entered into the equation for blacks.

CONCLUSIONS

The following results are suggested by this research and bear further investigation:

1. Taking Chemistry and Physics had a significant effect upon subscores and the NSR score, even with the inclusion of GPA and demographic variables into the models.
2. Biology grades had a significant effect upon subscores and the NSR score.
3. Females tended to perform less well in all areas except Chemistry.
4. Whites tended to perform slightly better than blacks in all areas.
5. Class size had no significant impact.
6. The course taken plus GPA regression equation on NSR tended to remain stable upon cross-validation, with minimal shrinkage.

It is clear that other factors contributed to the variation in scores, as evidenced by the large amount of variation unaccounted for by these models. Further research into the sex and race contribution would be appropriate, as would research into social factors such as motivation, testwiseness, and other affective variables. Some analysis of the subscores would be appropriate as well, to determine the degree of collinearity among them.

It is anticipated that the data from this and similar studies will give us a firm beginning from which to pursue further, similar studies, and to come closer to identifying the specific factors that make a student score well on the ACT Assessment Science test.

Table 5.1

Descriptive Data for Regression Variables
(N = 2337)

Scores	Range	Mean	SD
Natural Science Reading (NSR)	1-52	23.84	7.32
Chemistry	1-13	4.60	2.38
Biology	1-15	7.67	2.74
General Science	1-11	4.63	2.20
Physics	1-13	6.94	2.55
Courses (0 = Not taken; 1 = Taken)			
General Science	0-1	.71	.45
Biology	0-1	.92	.26
Chemistry	0-1	.74	.44
Physics	0-1	.35	.48
Course Grades[1]	N	Mean	SD
General Science	1579	3.12	.79
Biology	2102	2.95	.85
Chemistry	1500	2.79	.91
Physics	239	3.06	.89
Demographics	Range	Mean	SD
Race (1 = black, 3 = white)	1,3	2.90	.44
Sex (4 = male, 6 = female)	4,6	5.17	.99
Class size (1 = <25 ... 7 = ≥900)	1-7	3.60	1.16
GPA			
GPA (1 = D to D- ... 7 = A to A-, 0 deleted)	1-7	5.41	1.21

[1]Pairwise deletion

Table 5.2

Zero-Order Correlations

Scores:	NSR	Chemistry	Biology	General Science	Physics
Course grades					
General Science	.35	.26	.28	.22	.28
Biology	.39	.25	.32	.24	.32
Chemistry	.33	.24	.25	.19	.27
Physics	.32	.24	.32	.16	.27
Courses taken					
General Science	-.09	-.08	-.04	-.07	-.08
Biology	.10	.08	.09	.06	.06
Chemistry	.36	.29	.25	.23	.29
Physics	.39	.25	.29	.25	.36
Demographics					
Sex	-.15	-.03	-.10	-.16	-.16
Race	.14	.09	.10	.12	.09
Class Size	.01	.01	.00	.02	-.00
GPA					
GPA	.46	.32	.37	.30	.38

Table 5.3

Beta Weights for Regression of Scores on Courses Taken[1] (N = 2337)

Dependent Variable:	Natural Science Reading	Chemistry	Biology	General Science	Physics
Beta Weights for Courses Taken					
General Science	--	--	--	--	--
Biology	--	--	--	--	--
Chemistry	.25	.23	.17	.16	.19
Physics	.31	.17	.24	.19	.30
Multiple R	.46	.33	.33	.29	.40
R Square	.21	.11	.11	.09	.16

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.

Table 5.4

Beta Weights for Regression of Scores on Courses Taken and H.S. GPA[1] (N = 2337)

Dependent Variable:	Natural Science Reading	Chemistry	Biology	General Science	Physics
Beta Weights for Courses Taken					
General Science	--	--	--	--	--
Biology	--	--	--	--	--
Chemistry	.17	.17	.10	.11	.13
Physics	.22	.11	.16	.14	.23
Beta Weights for H.S. GPA					
GPA	.33	.22	.28	.22	.25
Multiple R	.53	.38	.42	.36	.46
R Square	.30	.15	.18	.13	.22

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.

Table 5.5

Beta Weights for Regression of Scores on Courses Taken, Demographics, and GPA[1] (N = 2337)

Dependent Variable:	Natural Science Reading	Chemistry	Biology	General Science	Physics
Beta Weights for Courses Taken					
General Science	--	--	--	--	--
Biology	--	--	.04	--	--
Chemistry	.16	.17	.08	.10	.12
Physics	.18	.12	.13	.09	.19
Beta Weights for Demographics					
Sex	-.15	--	-.11	-.17	-.14
Race	.10	.07	.07	.09	.06
Class Size	--	--	--	--	--
Beta Weights for H.S. GPA					
GPA	.36	.22	.31	.25	.28
Multiple R	.58	.39	.44	.40	.49
R Square	.33	.15	.20	.16	.24

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.

Table 5.6

Beta Weights for Regression of Scores on Course Grades[1] (N = 2337)

Dependent Variable:	Natural Science Reading	Chemistry	Biology	General Science	Physics
Beta Weights for Course Grades[2]					
General Science	.20	.26	--	--	--
Biology	.27	--	.22	.24	.32
Chemistry	--	--	--	--	--
Physics	--	--	.22	--	--
Multiple R	.42	.26	.38	.24	.32
R Square	.18	.06	.14	.06	.10

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.
[2] Pairwise deletion

Table 5.7

Beta Weights for Regression of Scores on Courses Taken and H.S. GPA by Sex[1] (n_1 = 1365 females, n_2 = 972 males)

Dependent Variable:	Natural Science Reading		Chemistry		Biology		General Science		Physics	
	F	M	F	M	F	M	F	M	F	M
Beta Weights for Courses Taken										
General Science	--	--	--	--	--	--	--	--	--	--
Biology	--	--	--	--	--	.07	--	--	--	--
Chemistry	.17	.16	.18	.16	.08	.09	.12	.08	.12	.12
Physics	.16	.19	.09	.12	.11	.14	.08	.10	.18	.19
Beta Weights for H.S. GPA										
GPA	.39	.36	.22	.24	.33	.30	.27	.24	.30	.28
Multiple R	.56	.55	.37	.40	.42	.43	.38	.34	.47	.46
R Square	.31	.30	.14	.16	.18	.19	.14	.12	.22	.21

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.

Table 5.8

Beta Weights for Regression of Scores on Courses Taken and H.S. GPA by Race[1] (n_1 = 2220 whites, n_2 = 117 blacks)

Dependent Variable:	Natural Science Reading		Chemistry		Biology		General Science		Physics	
	W	B	W	B	W	B	W	B	W	B
Beta Weights for Courses Taken										
General Science	--	--	--	--	--	--	--	--	--	-.21
Biology	--	--	--	--	--	--	--	--	--	--
Chemistry	.17	.29	.17	.22	.09	.26	.12	--	.13	.21
Physics	.23	--	.12	--	.17	--	.14	.28	.24	--
Beta Weights for H.S. GPA										
GPA	.33	.32	.22	.18	.28	.29	.21	--	.25	.30
Multiple R	.55	.48	.39	.32	.42	.44	.36	.28	.46	.47
R Square	.30	.23	.15	.10	.18	.19	.13	.08	.22	.22

[1] F to enter was 3.84; variables without reported beta weights did not meet this criterion.

Table 5.9

Regression Equations by Race and Sex for Course Taken and GPA on Natural Science Reading (NSR)

NSR = 2.01(GPA) + 3.37(P) + 2.85(C) + 9.69

NSR = 1.98(GPA) + 3.48(P) + 2.78(C) + 9.98 (whites) n_1 = 2220

NSR = 1.72(GPA) + 4.21(C) + 8.09 (blacks) n_2 = 117

NSR = 2.28(GPA) + 2.69(C) + 2.50(P) + 7.69 (females) n_1 = 1365

NSR = 2.19(GPA) + 2.87(P) + 2.79(C) + 10.20 (males) n_2 = 972